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ABSTRACT

The principle cause of hunger and malnutrition is poverty. The extent of popular access to gainful employment, to arable land, to suitable technologies determines nutritional status more than aggregate food production. World food production is rising; but population is also increasing, along with the numbers of those who, either temporarily or chronically, do not have sufficient food, although the proportion of the world's population suffering undernutrition is declining. The developing countries, with about three-quarters of the world's population, account for less than one-half of the production of major food crops. Those nations' per capita food production of 260 kilograms in 1982 was only one-third of that in the developed countries. Yet China and India, the most populous countries in the world, have cut fertility rates and achieved food self-sufficiency. Although production of food staples in North Africa and the Middle East is projected to expand at about the same rate as that of Asia, approximately 2.9 percent annually, a much more rapid rate of population increase will result in only a 0.2 percent annual increase in output per person, compared with a 1.4 percent annual growth rate in Asia. Balancing population, food, and resources for sustained survival is a continual process. Eighty-one references and a list of suggested readings conclude the document. (Author/SM)

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POPULATION BULLETIN
Vol. 43, No. 2, April 1988

Food and Population: Beyond Five Billion

By Peter Hendry

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Abstract—World food production is rising, but population is also increasing. And so are the numbers of those who, either temporarily or chronically, do not have sufficient food, although the proportion of world population suffering undernutrition is declining. We live in a world of over 5 billion people where feast and famine—food shortages and food surpluses—occur simultaneously. The U.S. government pays farmers not to plant crops, to cut surpluses and prevent further erosion, while also providing more than 19 million people a month with food stamps so they can obtain food.

The developing countries, with about three-quarters of the world's population, account for less than half of the production of major food crops. The Third World's per capita food production of 260 kilograms in 1982 was only one-third of that in the developed countries. Yet China and India, the most populous countries in the world, have cut fertility rates and moved to food self-sufficiency.

An illustration of the food/population dynamic is that although production of food staples in North Africa and the Middle East is projected to expand at about the same rate as that of Asia, about 2.9 percent annually, owing to a much more rapid rate of population increase, they will achieve only a 0.2 percent annual increase in output per person, compared with a 1.4 percent annual growth rate in Asia. In the longer term, higher dietary levels per capita for a world population double that of the present (the UN medium variant of 10.2 billion in 2100) would imply at least a tripling of demand for dietary staples. But more intensive cultivation would place natural resources, many already degraded, under much greater stress. Balancing population, food, and resources for sustained survival is a continual process.

The principle cause of hunger and malnutrition is poverty: the extent of popular access to gainful employment, to arable land, to suitable technologies determines nutritional status more than aggregate food production.

Editor: Roberta Yared
Production Assistant: Tracey A. Smith
Graphics: Joanna Lawrence

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U.S. Department of Agriculture

Wheat is the leading grain/cereal produced worldwide, with rice a close second.

Food and Population: Beyond Five Billion

By **Peter Hendry**

Peter Hendry was Chief Editor of Ceres, *the review of the Food and Agriculture Organization of the United Nations from 1977 to 1987. He had previously served as Senior Information Advisor for FAO, North American Region, in Washington, D.C. between 1969 and 1977 and as Editor of Canada's national farm magazine,* Family Herald, *from 1964 to 1968. The Canadian editor and writer is presently a free-lance writer based in Guelph, Ontario, continuing his specialization in issues relating to international agricultural development.*

The author notes with gratitude the advice and assistance of Joop Alberts, FAO Population Program Coordinator, and Alain Marcoux of the FAO Economic and Social Policy Department at FAO headquarters in Rome, Italy.

In a world noted for the celebration of anniversaries of every variety, perhaps it is not too soon to ponder what kind of commemoration will be accorded the bicentennial, only a decade away, of the publication of Thomas Malthus' treatise, *An Essay on the Principle of Population*. We must recognize his contribution as a founding father of population study and in signaling the relationship between the growth of human population and its ability to feed itself. But, as we close out the twentieth century with 4 times the human population it had at its beginning, will we be obliged to acknowledge his foresight or permitted to celebrate his misjudgment?

Malthus said—to oversimplify—that there would always be too many people, too little food. (See Box 1, page 4.) There have been, of course, developments he could scarcely have foreseen: expansion of world cropland to more than double its 1850 acreage; development of agricultural technologies capable of quadrupling yields achieved by traditional farming methods; and the evolution of international networks of trade, communication, and cooperation leading to a degree of global interdependence inconceivable in the eighteenth century. The global trends toward industrialization and urbanization; the diffusion of health services and improved hygiene, lowering death rates and then birth rates; and the political independence of hundreds of millions of people formerly under the colonial rule of European countries have equally changed the situation since the lifetime of Malthus. He would never have predicted, for instance, farmers being paid not to plant, in order to cut surpluses and to reverse erosion, that reduced the harvested area of cereals and soybeans in America by 10 percent in 1986. U.S. farm subsidies mounted to more than $26 billion in 1987, while food stamps were distributed to over 19 million individuals to enable them to obtain food (average monthly number of recipients in fiscal year 1987 was 19.1 million). And he would be amazed at a growth in world population of 548 million from 1980-1987.

Famine, hunger, and malnutrition are now considered remediable afflictions of humanity that could be eliminated. Generous contributions are made to alleviate situations in which people face a critical food shortage and techniques and technology from several disciplines continue to expand production.

Box 1. Malthus on Population

Thomas Robert Malthus (1766-1834) reasoned as follows:

"First, That food is necessary to the existence of man.

Secondly, That the passion between the sexes is necessary and will remain nearly in its present state. ...

Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. A slight acquaintance with numbers will shew the immensity of the first power in comparison of the second. ... the human species would increase in the ratio of 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, &c. and subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, &c. ...

Through the animal and vegetable kingdoms, nature has scattered the seeds of life abroad with the most profuse and liberal hand. She has been comparatively sparing in the room and the nourishment necessary to rear them. ... And it appears, therefore, to be decisive against the possible existence of a society, all the members of which should live in ease, happiness, and comparative leisure; and feel no anxiety about providing the means of subsistence for themselves and their families.

Consequently, if the premises are just, the argument is conclusive against the perfectibility of the mass of mankind."

Malthus summarized his thinking in his principle of population: "The power of population is indefinitely greater than the power in the earth to produce subsistence for man." The fluctuations of this "perpetual oscillation" between population growth and food supply cause "misery and vice" as do the checks on population increase, namely starvation, disease, wars, and sexual restraint.

One of the first reactions to *An Essay on the Principle of Population* in the England of 1798 was Prime Minister William Pitt's withdrawal of his Bill to aid the poor from Parliament, following the advice in the *Essay*. The short pamphlet was published anonymously, when the Rev. Robert Malthus was both a Fellow of Jesus College at Cambridge University and an Anglican curate in Surrey. Malthus graduated with honors as a mathematician from Jesus College and had been ordained by the Church of England, despite a speech impediment from a cleft palate. He had to resign from Cambridge in 1804 to marry at the age of 38 (they eventually had three children). Malthus held the first chair of political economy in England, at the College of the East India Company from 1805 until his death in 1834. He developed the concept of diminishing returns in his later economic writing, and revised the *Essay* through seven editions.

The full title of his first, and most famous, work is *An Essay on the Principle of Population, as It Affects the Future Improvement of Society, with Remarks on the Speculations of Mr. Godwin, M. Condorcet, and other writers*. Malthus wrote it to reply to ideas put forth by Robert Wallace, Benjamin Franklin, William Godwin, the Marquis de Condorcet, and others following the American and French Revolutions. It was written as part of an ongoing—and still continuing—debate about man and society.

Quotations are from Malthus, *On Population*, Gertrude Himmelfarb, ed. (New York: The Modern Library, Random House, 1960)

So the debate continues. Is Malthus, ultimately, correct? Are there too many people? Do our new skills and knowledge merely postpone his pessimistic scenarios, or prove him wrong? Have we developed a sustainable balance between people and resources? Can we eliminate hunger? The variety of national experiences and circumstances establishes a diversity of perceptions on the subject.

We live in a world of more than 5 billion people where feast and famine occur at the same time, simultaneous food shortages and food surpluses. This *Bulletin* will explore probable causes and possible remedies of the problem of human hunger in seeking a clearer understanding of the relationship between food and population.

Global Nutritional Status

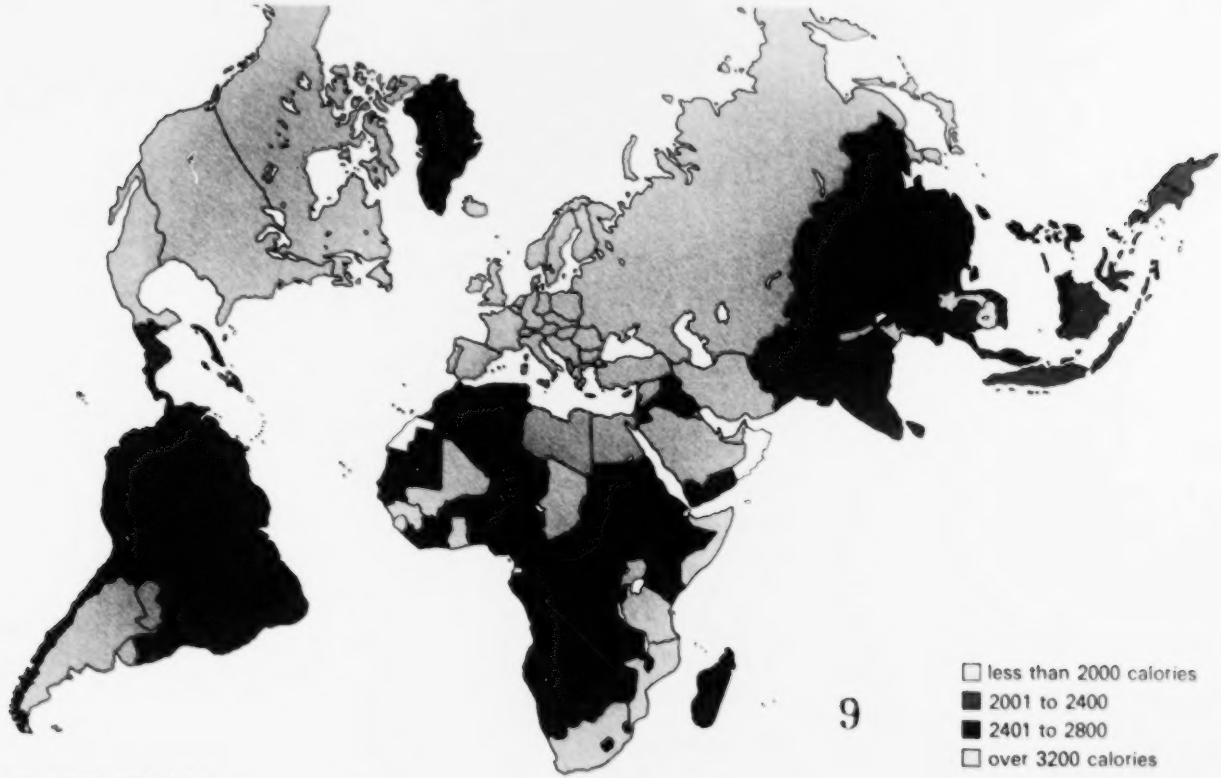
Any debate concerning whether we are winning or losing the battle to reduce world hunger is reminiscent of the hoary argument about whether a glass is half empty or half full. The evidence for either case seems irrefutable. Our convictions appear to be conditioned as much by viewpoint as by statistics. Consider, for example, the following sets of statements:

- During the 1970s world population increased by 750 million. Most of this growth occurred in poor countries, where undernutrition is most serious. In developing countries with market economies, for instance, population increased by 470 million and the number of undernourished there grew by an estimated 22 million. Although their number increased, the proportion of the world's population suffering from undernutrition declined. Undernutrition here usually means diets which do not provide enough energy for a normal working, physically active life, as well as the temporary or chronic lack of food which can lead to illness and death.
- During the period 1961-80 food production in developing countries expanded by 3.1 percent a year—significantly faster than population, which grew 2.4 percent a year.[1]
- In the two decades between 1961 and 1981, global food supplies, expressed in terms of dietary energy per person per day, increased from 2,340 to 2,630 calories. (Per capita dietary energy supplies are measured as energy equivalents of quantities of food items available for human consumption.)
- Among 112 countries included in the Fifth World Food Survey of the Food and Agricultural Organization (FAO), 75 nations achieved at least some increase in per capita dietary energy supplies in the period between 1961 and 1980 for their 2.8 billion populations. China and India, two of the most populous countries in the world, became self-sufficient in grain/cereal production.
- In 1985, while world media attention focused on the dramatic food crisis in Ethiopia, 12 African countries were able to produce cereal surpluses totalling nearly three and a half million tons.[2]

On the other hand:

- The developing countries, with about three-quarters of the world's population, account for less than half of the production of major food crops.
- The Third World's per capita food production of 260 kilograms in 1982 was only one-third of that in the developed countries. A level of 180 kilograms, around one pound of grain/cereal daily, is considered a subsistence threshold below which lies the malnutrition that stunts physical and mental growth and makes normal physical labor too difficult to maintain.
- In 26 countries, representing 8 percent of the population of the developing countries surveyed, dietary energy supplies per person actually declined during the 1970s. There was a decline in five countries where per capita dietary energy was already 2,100 calories or less: Bangladesh, Guinea, Mali, Mozambique, and Sierra Leone. In 11 countries there was virtually no change in dietary energy supplies, including the following where dietary energy per person remained at 2,100 calories or less: Burkina Faso, Haiti, Nepal, and the islands of St. Christopher and Nevis. North Americans and Europeans averaged over 3,000 calories per capita per day.[3]
- Production of basic food staples in sub-Saharan Africa grew at only 1.7 percent a year during the two-decade period 1961-1980, largely due to poor performance in West Africa where food production was outstripped by population growth by more than two full percentage points.[4] Africa's annual growth rate in food production between 1980-86 was only 2.9 percent, compared to population growth of at least 3 percent.[5]

Figure 1. Average Daily Calorie Supply Per Person



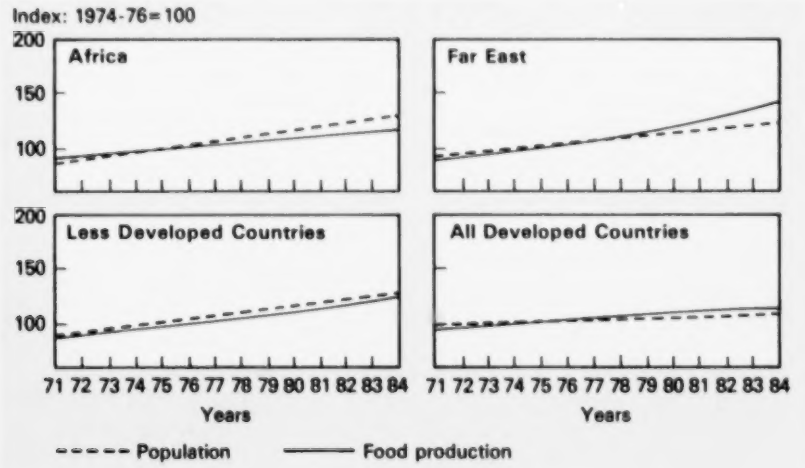
Source: FAO, 1979-81 data.

Vulnerability

What becomes obvious from these apparently contradictory trends is that global averages are of limited usefulness in trying to understand the nature and scope of undernourishment or its relationship to demographic patterns. The need for caution in citing global statistics can be demonstrated by breaking down overall figures to at least the regional level. During the period 1961-80, developing countries, lumped together, showed an annual average increase in food production of 3.1 percent—comfortably above the average annual population growth rate of 2.4 percent. This apparent progress, however, could be mainly attributed to significant production gains in China, which accounts for about 30 percent of the Third World's population and 35 percent of its food output. If China is removed from the calculation, food production gains in other developing countries barely matched population growth. On a regional basis, Asia and Latin America were able to keep food production growing faster than population, but the reverse was true in North Africa, the Middle East, and, especially, sub-Saharan Africa (see Figure 2). However, food production was growing more rapidly than population in some of the world's most populous developing countries, notably Brazil, China, India, and Indonesia.[6]

To identify the people and the locations most vulnerable to hunger requires a much more detailed scrutiny of available data. Access to food varies enormously not only between affluent and impoverished nations, but also within national borders, among different economic and social classes sharing the same locality, and even among members of the same household sharing a common larder. While there is irrefutable evidence that poverty is the most evident common denominator among nations, communities, or households afflicted by chronic undernourishment, it is not the sole determinant. Individual and col-

Figure 2. Growth of Population and Food Production: 1971-1984



Source: FAO

lective responses to the stress of food deficiencies are shaped and conditioned by cultural traditions, social organization, and the political environment.

Under these circumstances, some experts doubt whether it is possible to make an accurate estimate of the global extent of undernutrition.[7] It is generally agreed that undernutrition affects a significant proportion of the Third World's population and that the principle cause of this is poverty. The extent of popular access to gainful employment, to arable land, to suitable technologies, and to other productive resources is likely to be a far more important factor in determining levels of undernourishment than a nation's aggregate food production relative to population.

Food consumption data from developing countries are scarce, especially those comparing rural-urban consumption patterns. One recent survey covering 13 countries in all developing regions indicated that, in every case, average food consumption in urban areas was lower and estimates of undernutrition generally higher than among rural populations. On the other hand, physical malnutrition among children was notably worse in rural areas. Where data were available by income groups, these urban-rural differentials persisted at all levels in Brazil, India, and Tunisia, to cite three cases in different regions. A number of reasons have been suggested to explain this paradox. It is possible that available consumption statistics do not adequately reflect foods which the urban poor obtain and eat outside the home. The better nutritional status of urban children may reflect better access to medical and sanitary facilities, higher quality food, and a more steady supply of food. Urban energy demands are also likely to be less than in rural areas, due to a more sedentary style of life.[8]

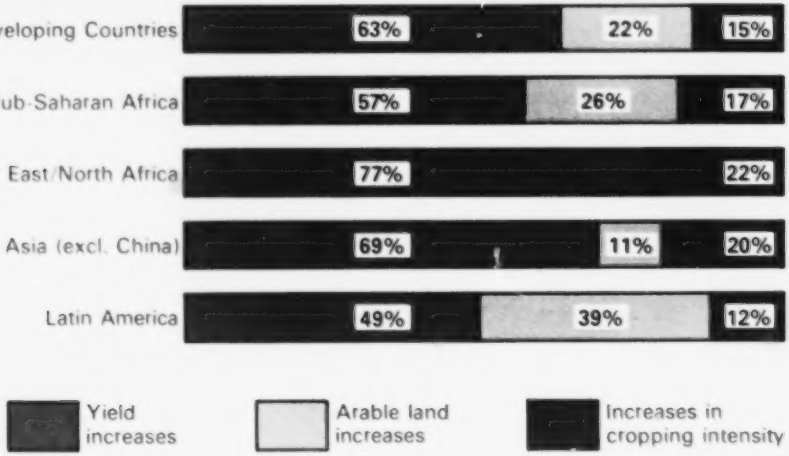
But more dramatic than rural-urban differences are those evident between social classes and income groups. In Manila where per capita daily energy intake in slum areas averages about 200 calories less than in planned residential zones, the incidence of low birth weight was 5 times higher, infant mortality 3 times higher, and severe or moderate malnutrition and anemia twice as frequent in the Philippine slums.[9]

In New Delhi, India, among certain castes in which nearly all women worked in unskilled jobs, death rates of children below 5 years of age reach 444 per 1,000.[10] In Abidjan, Côte d'Ivoire it has been calculated that the probability of dying between 1 and 4 years of age is 15 times greater in slum areas than in more affluent quarters of the city where housing—and mortality rates—are comparable to those in developed countries.[11]

While there has been ample evidence that the Western public is increasingly aware of, and responding to, the desperate plight of the poor in several regions of Africa, some experienced observers question whether the situation presented so dramatically on television screens around the world was not simply the destitution and misery which is the "normal" lot of poor populations in remote areas. "The outside world," says Allan G. Hill, a senior lecturer at the Centre for Population Studies at the London School of Hygiene and Tropical Medicine, "rarely has the chance to discover these high levels of rural poverty but when the destitute collect on roadsides, in refugee camps or on the outskirts of towns and cities, the depths of rural poverty may be being appreciated perhaps for the first time."[12]

He cites demographic surveys conducted in central Mali during 1981-85 which reveal no signs of a peak in child mortality during or just after the 1973-74 drought. Child mortality levels, Hill points out, have been rather constant since the 1950s. What can happen in specific localities is demonstrated by the situation in Mopti, Mali, where child mortality has risen recently as a result of the arrival of destitute groups. About 40 percent of the children of the recent immigrants die before their fifth birthday compared with about 30 percent among long-term residents of the town.

Figure 3. Possibilities of Increased Food Production: 1982/84-2000



Source: FAO

Factors in Increased Food Production

Food production increased in Third World countries, excluding China, by an annual average of 2.9 percent in the 1960s and 2.6 percent in the 1970s. In the '60s, expansion of the area being planted and increased output per hectare (approximately 2.5 acres) contributed about equally to production growth while during the 1970s more than two-thirds of the increase could be attributed to higher yields per hectare.[13]

A recently revised FAO survey of 93 developing countries estimates that to meet food production requirements at the end of this century, another 83 million hectares will have to be added to the present 770-million-hectare area of farmable land, and cropping intensity will have to be increased from 78 to 84 percent, thus allowing for an additional 115 million hectares of harvested land.[14] At first glance, such expansion would appear modest in comparison with the 1.3 billion hectares of arable land that would still be in reserve at the end of the century, but the FAO study cautions that most of these reserve areas contain soils of marginal quality and some are located in regions of unreliable rainfall. Moreover, much of the reserve land is located in just two countries, Brazil and Zaire. Most developing nations will have to depend on better yields and multiple crops from the same land (increased cropping intensity) to achieve higher food production (see Figure 3). However, substantial yield increases obtained during the 1960s and 1970s for rice and wheat grown on irrigated land are yet to be matched with similar advances in other basic food crops such as barley, millet, and pulses (peas and beans) normally grown with only natural rainfall. Only some 7 percent of African cropland is irrigated, for example, two-thirds of the total being in Egypt, the Sudan, and South Africa.[15] High-yielding varieties developed for one area may not transfer smoothly to other parts of the world. The rice strains producing the "Green Revo-

lution" in Asia do poorly in African environments, and require amounts of water, pesticides, and fertilizers few African farmers can provide. Rice varieties for rainfed uplands, mangrove swamps, and irrigated land are now being developed for African growing conditions and tastes at a research center in central Côte d'Ivoire.[16]

For many developing countries endeavoring to enhance national food security, stable production levels of basic food crops is at least as important as obtaining dramatic yield increases. Yet, with few exceptions, the output of major staple foods has been unstable in developing countries. From studies of variations in food production in 18 developing countries, the World Bank has calculated that over the 10-year span between 1968 and 1978, the average coefficients of variation were 18 percent for wheat, 14 percent for maize, and 8 percent for rice. The respective global figures were 5, 4, and 3 percent.[17]

While it has been customary to attribute yield increases to the introduction of modern agricultural inputs and technologies such as those associated with the Green Revolution in India, a longer range perspective on traditional farming systems suggests that these are in no way as stagnant as is often imagined and have, indeed, been adapting both to external markets and to changes in population densities. The introduction or increased use of organic manuring and draft animal power for cultivation have been representative of such adjustments as farming practices have shifted to more intensive cropping. Some studies have indicated that identical or strikingly similar solutions to the need for increasing food production have been found independently by farmers themselves in many places all over the world.[18] The critical question, of course, is whether farmers' own innovations and their related investments will continue to match growing food demand in the Third World, or whether, as has been the case for agriculture in the industrialized world, more science-based technology will have to be introduced.

A major problem is that most developing countries have generally opted for "cheap food" policies, welcoming food aid and easy credit to purchase their staple cereals from surplus-burdened developed countries. When successive and widespread crop failures in the early 1970s suddenly pushed cereal prices to 3 times the existing level, these countries were in trouble. The damage that such policies and related measures have done to the domestic agricultural sector which

Table 1. People and Food: World's Ten Most Populous Countries

	Population 1988 (est.) (millions)	Total Fertility Rate* 1987 (1980)	Grain Yield kilograms/ hectare	Arable Land % of Total	Daily Calorie Supply per capita (1985)	GNP (US$) per capita (1985-86)
China	1,080	2.4 (2.3)	3,825	11	2,602	300
India	817	4.3 (5.3)	1,566	57	2,189	270
USSR	286	2.5 (2.4)	1,563	10	3,440	7,400
U.S.A.	246	1.8 (1.8)	4,279	21	3,663	17,500
Indonesia	177	3.3 (4.1)	3,413	11	2,533	500
Brazil	144	3.4 (4.4)	1,708	9	2,633	1,810
Japan	123	1.7 (1.8)	5,705	13	2,856	12,850
Bangladesh	109	5.8 (6.3)	2,125	68	1,899**	160
Pakistan	107	6.6 (6.3)	1,605	26	2,159	350
Nigeria	106	6.6 (6.9)	719	33	2,038**	640

*Total Fertility Rate is the average number of children born to a woman during her lifetime.
**Declined from 1965 figure.

Sources: FAO, International Institute for Environment and Development/World Resources Institute, World Bank, PRB *World Population Data Sheet 1987* and *1988*.

remains the predominant industry and activity in most developing countries has been recognized. Change is not easy, even at the best of times, and this is a period of economic crisis when North American and Western European nations, major agricultural exporters, are engaged in fierce competition for world markets. Many developing countries face problems with volatile masses of unemployed or underemployed migrants who have moved to major cities from rural areas. The provision of cheap food becomes necessary if the government wishes to avoid trouble over price increases on staple food items: troops have had to be called out to quell food-related riots in Brazil, Egypt, and Tunisia in recent years.

Shift from Subsistence Farming

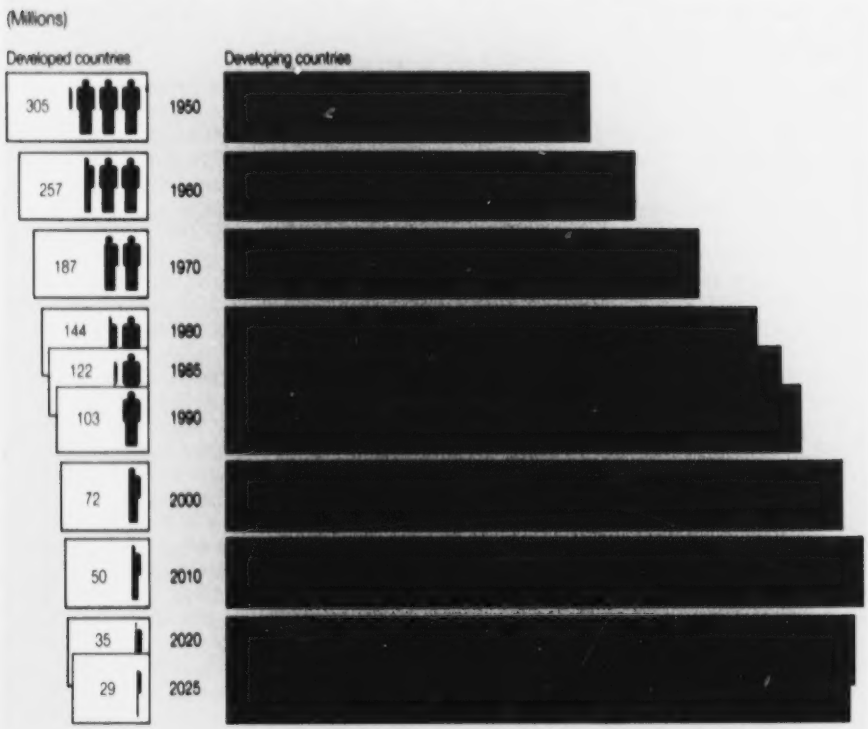
Any pronounced shift to modern agricultural technology implies corresponding structural changes in traditional agricultural systems. In regions where subsistence agriculture predominates and as much as two-thirds or more of the total population are engaged in agrarian pursuits, a farm family of five may find a market of not more than two other persons to purchase surplus food from their output. As the proportion of agricultural population declines, the potential market for surplus production increases. With 20 percent of total population engaged in agriculture, it is estimated that the average family farm unit could find a market for as many as 20 additional persons.[19]

Opportunities for traditional rural societies to materially enhance their standard of living are closely linked to the decline in the proportion of the farm population. About half the population of the world today is working or seeking work in agriculture. Only 10 percent of the population in the developed countries in 1985 were in the agricultural sector, shrinking from 38 percent of the population in 1950. There has been a much slower diminution in the developing nations, from 81 percent in 1950 to 63 percent in 1985 (see Figure 4). A drop to 38 percent is foreseen in the year 2025.[20] The decline in the agricultural work force in the developed states was matched with a consequent rise in productivity, so that the average family in these countries had food budgets that normally did not exceed 30 percent of disposable income. The European Economic Community has continual political problems setting production levels and cutting subsidies, yet a February 1988 study says the number of farmers in the 12 Common Market countries will continue to fall, going from a current 10 million to 5 million by the end of the century.[21] One explanation for the "butter mountains" and other surpluses is that farming productivity has increased 25 percent in the past quarter century in France alone.

The size of the overall domestic population as well as export opportunities are obvious influences in the shift to commercial farming. However, one point seems clear: in the earliest stages of transition from traditional subsistence agriculture to commercial farming, production incentives arising from the domestic marketplace are generally weak. At the same time, demand for purchased inputs for food production is also restricted.

What has happened in many developing countries, however, is that modern technology has been introduced only to a relatively small segment of the agricultural sector, most frequently that producing export crops. The result is a bimodal pattern of agricultural development in which highly commercial farm enterprises, usually comprising a fifth or less of the national total, may account for two-thirds or three-fourths of all marketed output, while a traditional sector remains trapped in its stagnant environment, ill-equipped to compete with the modern sector for land, labor, or other inputs.

Figure 4. The Agricultural Work Force: 1950-2025



Source: FAO

Environmental Degradation

Ever more intensive use of land and water resources in order to meet demands from rapidly expanding populations for increased food production carries implications for the sustainability of those resources. There is tangible evidence that resources necessary for food production in many regions are under severe stress: we can see the "progress" of deforestation, soil degradation, and desertification. This has inspired predictions that global environmental degradation will soon threaten human survival itself. Many such warnings have assumed a direct link between population growth and environmental deterioration and have reached over-simplified general conclusions. Poor land management, poverty, inappropriate technologies, and other factors join population growth as culprits. But "the greater the population and the higher its energy use, the greater the entropy effect. . . . there is no free ride in nature."[22]

Population density, for example, is not an infallible indicator of the pressure upon resources. While there is evidence that growing population pressures have

contributed to the shortening of periods where the land rests fallow in traditional agricultural systems and to removal of forest cover, simply tabulating the number of people per square kilometer doesn't tell us much about the relationships between population and resources. Declining population in the Himalayan foothills of Nepal has coincided with increased problems of erosion, for instance, because migration to the cities has claimed those who were most capable at terracing and other soil conservation techniques.[23]

The 1974 World Population Conference in Bucharest, Romania recommended more unified and analytical research into "the complex relations among the problems of population, resources, environment and development" but progress in this field remains limited.

Some general patterns, however, may be detected. One consequence of rapid population growth in the Third World has been the dramatic increase in urban populations. Urbanization in Africa, for example, has the highest growth rate in the world, estimated at 4.9 percent for the period from 1985-1990. While the process started later in the developing countries, the estimated size of the urban population was nearly the same in developed (698 million) and developing (673 million) by 1970. Over 40 percent of world population in 1985 were urban residents, and the percentage is expected to pass 50 percent before the year 2010, according to United Nations projections.[24] This rapid urbanization, combined with continuing growth of rural populations as well, makes less feasible those traditional farming systems based on extensive use of land. Given less land and increased pressure for more foodstuffs, fallow periods are shortened or even eliminated and more land that is marginal and submarginal for agriculture is used for growing crops.[25]

One study has estimated that more than 1.1 billion people are living in areas of the developing world where the population has already exceeded the carrying capacity of the land.[26] Narpat S. Jodha, who heads the Farming Systems Division of the International Center for Integrated Mountain Development (ICIMOD) in Nepal, maintains that the problem of overexploitation and degradation of natural resources is greater in the low-productivity, high-risk environments such as dry tropical regions. He cites the depletion of India's so-called "common property" resources as an example. In the past, commonly held resources such as forests, pastures, and wastelands were an important element in the villagers' system of self-provisioning. It has been estimated that such resources contributed, directly or indirectly, as much as a quarter of total household income. But as land use has intensified, common property resources have been severely affected. Regardless of their suitability, many have been converted into cropland under private ownership. Recent studies in 80 villages in the dry tropical zones of seven Indian states indicate that the areas set aside as common property resources have declined between 31 and 55 percent, depending on location. Pressures on the remaining common lands have consequently increased. Many products that villagers once gathered regularly from the commons are now no longer available. The number of watering places, vitally important for common grazing lands, has also declined.[27]

Prospects for the Future

Population Projections

The population projections that have been made for the near term are considered relatively secure. Even though the historic peak in global population growth rates—2 percent per year in the 1960s and early 1970s—is now behind us, the absolute annual population increase will continue to rise because of demographic momentum. In 1987, the

annual increase was 87 million, including 17 million Indians and 15 million Chinese. Annual population increases are projected to grow to a high of about 90 million in the late 1990s, before they begin a long period of decline.

But while the world's population as we enter the 21st century can be reasonably anticipated at slightly above 6 billion and at 7 billion a little after 2010, projections beyond that point become more speculative. For instance, the Chinese birth rate recently took an unexpected upward swing and India's fertility decline has not been as rapid as projected. The United Nations Population Division offers four scenarios for the year 2100, with global populations ranging from a low of 7.2 billion to a high of 14.9 billion, depending on fertility levels attained over the next 50 years. UN projections for the year 2025 range from 7.4 billion (low variant) to 8.2 billion (medium variant) to 9.1 billion (high variant).[28]

The UN medium variant offers a world population stabilizing in the year 2100 at 10.2 billion, approximately double present global population. To achieve this, however, would require that world fertility decline to the replacement level of approximately 2.1 children per woman by the year 2035. (Fertility is presently estimated at 3.6 per woman, ranging from 8.5 in Rwanda and North Yemen to 1.4 in West Germany and Italy.)

The timing of changes in fertility has an enormous impact on the ultimate level of population reached over a given period. If the date for achieving replacement-level fertility is delayed by 20 years, the global population at the end of the next century would be 2.8 billion greater than the projected medium variant. On the other hand, if replacement-level fertility were to come 20 years earlier, i.e., in 2015, the century-end population would be 2.2 billion less. The difference adds up to the equivalent of the world's total present day population.[29]

Developing countries account for 95 percent of the total population increase between now and the middle of the 21st century. By the year 2025, the UN projects that 83 percent of the world's population will be in the less developed regions, with some 6.8 billion people compared to 1.4 billion in industrialized countries (see Table 2). Regional variations in growth rates will cause considerable shifts in population distribution. The world's most populous region, Asia, is projected to have the slowest population growth rate in the developing world, 1.1 percent through 2025 compared with the 2.3 percent annual average recorded during the 1960s and 1970s. This substantial reduction can be largely attributed to China's achievement in reducing population growth to just over 1 percent per annum. If current trends continue, India may be the most populous country in the world at century's end. Thus, even with China's drop in fertility, Asia's population by the end of this century, at 3.5 billion, will represent about three-fourths of the Third World total and would be more than half of the world population.

Africa, with a present growth rate of 2.8 percent that would double its population in 24 years, is expected to emerge as the second most populous region of the world. A slight decline in the rate of growth is not expected until early in the 21st century. Africa's population is expected to reach one billion, double its 1982 level, some time between 2000 and 2005.

Latin America, like Asia, is projected to show a significant deceleration in population growth. Its projected growth rate of 2.1 percent will bring it to a population of over 540 million by the end of this century. The low growth, below replacement level patterns exhibited in Europe, North America, and Japan are projected to continue well into the next century. Though relatively small, the absolute growth in the more developed countries population would be in the order of 270 million, roughly equivalent to the present population of the Soviet Union (and much of that would result from immigration

Table 2. Population Projections of Major Regions of the World, 1985-2025

(in millions)

	United Nations*			World Bank		
	1985	2000	2025	1985	2000	2025
World	4,837	6,122	8,206	4,840	6,176	8,188
Less Developed	3,663	4,845	6,809	3,663	4,913	6,850
Africa	555	872	1,617	560	871	1,495
Latin America	405	546	779	398	529	715
Asia & Oceania	2,703	3,427	4,414	2,704	3,513	4,639
More Developed	1,174	1,277	1,396	1,177	1,263	1,338
USSR & E Europe	391	435	499	389	426	469
Other Developed	783	842	897	788	837	869

*medium variant

Note: More developed countries comprise all of North America, Europe, the USSR, Japan in Asia, and Australia and New Zealand in Oceania. Yugoslavia is included in other developed countries.

Sources: UN, World Bank

from the developing countries and from growth in the eastern republics of the USSR).

No less significant than the future distribution of population among countries will be the distribution of population within countries. Overall, urban areas in the Third World are projected to grow by over 3 percent annually, accounting for two-thirds of the total population growth in these regions. Large cities will grow even faster. By the end of this century the Third World will have 50 metropolitan areas each with over 4 million population, compared to 28 such centers at the present time. Three out of four people in Latin America and two out of every five in Asia and Africa will be urban residents.

As much as half of this rapid urban growth can be attributed to migration from rural areas. And, indeed, migrants' impact on urban growth may be even greater than a tabulation of their mere numbers would indicate, since the majority of them are young adults and will have higher birth rates than the urban population as a whole.[30]

Projected Food Requirements

If per capita income in the Third World continues to grow at the same pace as it has the past two decades, overall demand for food will expand at a rate of about 2.7 percent per annum. This is significantly above projected overall population growth rates, but slightly less than the projected rate of increase in food production.[31]

On a regional basis, however, only Asia, where food demand is projected to expand at the relatively slow rate of 2.3 percent, will be able to register a growth rate in the output of food staples higher than that of demand. For the rest of the developing world, food demand will grow at rates exceeding 3 percent annually. The most rapid regional expansion is anticipated in North Africa and the Middle East where significant income gains will combine with fairly rapid population growth to accelerate food demand to 3.8 percent per year, or nearly a full percentage point above the region's projected growth rate in food production. In sub-Saharan Africa, rapid population growth will be the major element in boosting food demand at a rate of 3.6 percent annually, substantially above the projected rates of increase in food production.

In the longer term, higher levels of per capita energy intake for a world population double the present 5 billion imply at least a tripling of demand for dietary sta-

ples. This would represent a two-edged challenge to the agricultural sector. On the one hand, in order to produce the equivalent of about 10 billion tons of grain annually, yields matching the 7 tons per hectare obtained by Iowa corn farmers would be required from all of the world's presently cultivated cropland, which currently averages only about one-third of that amount.[32] On the other hand, more intensive cultivation, particularly in tropical zones, would place food production resources under much greater environmental stress.

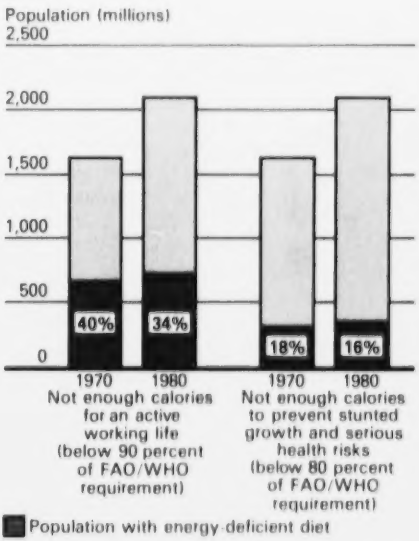
The Gap Between

The World Bank has estimated that there are between 340 million and 730 million people in developing countries (excluding China) who lack the income to ensure an adequate intake of dietary energy. The lower estimate is based on a minimum dietary standard that would avoid serious health risks and prevent stunted physical and mental development in children. However, if a nutritional standard is established to make allowance for an active working life, the estimate of those unable to afford it rises to 730 million.[33] The World Bank estimates that 80 percent of those who are undernourished live in countries with very low average incomes, two-thirds of the total residing in Asia and one-fifth in sub-Saharan Africa.

Although the number of individuals lacking adequate diets is enormous, the total deficiency in their diets is, in most countries, usually equivalent to less than 10 percent of the national food supply. Unfortunately, since elements other than availability enter the picture, merely increasing the food supply is not necessarily a guarantee that undernutrition will be reduced. In the longer term, the problem will be addressed most effectively by ensuring sufficient income-earning opportunities for households chronically short of food. Obviously, in cases where agriculture remains a major element in the economy, well-directed efforts to improve this sector should increase both the availability of food and the disposable income needed for its purchase.

If per capita food consumption in developing countries remains at 1980 levels through to the end of this century—in other words, if no allowance is made for growth in per capita income—requirements for the basic staple foods would be about 1,315 million tons. However, if income growth followed the 1966-1980 trend line, a further 225 million tons would be needed. This projection implies a net food deficit in developing countries of 69 million tons by the year 2000, some 30 percent greater than the deficit at the beginning of the 1980s—even though domestic output of major food crops is

Figure 5. Population with Deficient Diets, 1970 and 1980



Note: 87 developing countries
Source: World Bank

projected to expand by 75 percent through the last two decades of the century.[34]

Here again, regional differences in how population and income grow result in different degrees of pressure on domestic food production. For example, production of basic food crops in North Africa and the Middle East is projected to expand at about the same rate as that of Asia, i.e., 2.9 percent annually, but, owing to a much more rapid rate of increase in population, they will achieve only a 0.2 percent annual increase in output per capita, compared with a 1.4 percent annual growth rate in Asia.

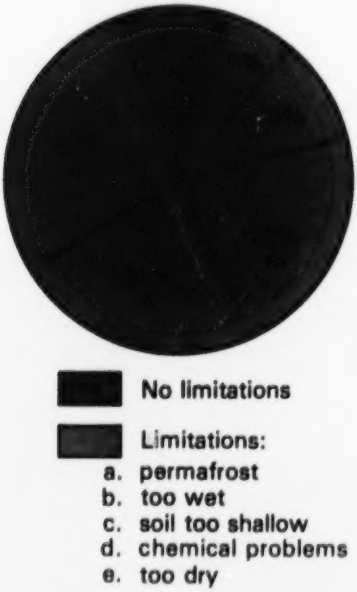
The Earth's Carrying Capacity

The accumulated evidence that rapid population growth may eventually place undue stress on food production resources to the detriment of national food security objectives raises questions about the longer-term capacity of resources within given political boundaries to sustain present or potential populations. One approach linking population with the local natural resource base is the concept of carrying capacity, borrowing the work of biologists on the maximum population of a species that a habitat can sustain. One ambitious study of this type analyzed soil and climate data from 117 developing countries to estimate food production potential in each zone for 15 major crops at three different levels of farming practice: low input, subsistence agriculture; intermediate, with the introduction of some modern technology, conservation measures, and improved cropping patterns; and high level, equivalent to farming practices in industrialized countries.[35] The maximum population that can be sustained by the food output of each country was established on the basis of an average calorie and protein intake recommended in 1973 by a joint committee of the World Health Organization (WHO) and FAO. Projected age and sex distribution of the population was also taken into consideration in calculating each country's requirements.

This type of study, of course, has many limitations. It makes virtually no pretense of being based on economic analysis. Calculations are based on the assumption that all potentially arable land will be used to grow only food crops, with no allowance for cropland to provide livestock feed or to produce non-food cash crops. The elimination of inequities in food distribution within countries, which would clearly increase average food requirements, are not included in the calculations. And although the study is careful to point out that its task was to assess the potential for food self-sufficiency in each country, and not to suggest that this was necessary or desirable, no consideration is given to other national resources or to the potential role of trade. However, many of these simplifying assumptions that are inevitable in any global study can be avoided in similar national studies, now being undertaken in a number of countries.

Among important considerations to emerge from the study's findings are, first, the degree to which figures aggregated globally can obscure potentially critical situations within countries and regions, and, second, the enormous advances in potential population-carrying capacity possible with improved techniques and practices. At the global level, the study indicates that subsistence-level agriculture would have been capable of supporting more than double the 1975 population of 2 billion in the 117 countries surveyed. By the end of the century, however, the margin provided by this level of agriculture will have narrowed significantly. While theoretically capable of supporting 1.6 times the anticipated population of 3.6 billion, no allowance is made for non-food crops or for population expansion in the next century. On the other hand, intermediate levels of agriculture could theoretically support 4 times the population projected for the year 2000 and high-level inputs and

Figure 6. World Soil Suitable for Agriculture



Source: FAO

practices 9 times that population.

It is at the country level that the study's findings assume their most disturbing aspect. Of the 117 countries studied, 54 would have been unable to feed their 1975 populations, a total of more than a billion people, from subsistence-level agriculture. The "excess" population in these countries was calculated at 278 million—more than 25 percent of the total. For the 1975 population levels, however, intermediate-level agriculture would have reduced the number of countries at risk to 24 with only 4 percent of the total population and high technology agriculture would have led to 13 countries in critical condition, with a mere 1 percent of the total population. By the end of the century, however, a projected 83 percent increase in population over the 1975 figure would increase the number of critical countries to 64 at low-level agriculture, 28 at the intermediate level, and 17 at high levels of farming technology.

An analysis of the 64 countries projected to face potentially critical food shortages by the end of the century at low levels of input indicates that most have limited reserves of usable land; two-thirds of these countries are already cultivating more than 70 percent of their potentially arable land. The great majority already face ecological problems. More than half of them are either islands or landlocked nations. While a few of these countries are major oil exporters and can thus afford to offset domestic food deficits with imported supplies, more than half are relatively poor.[36] The main under-utilized areas, in terms of carrying capacity, are to be found in the humid tropics, where, for a variety of reasons, human populations have been reluctant to settle. Conversely, much of the cool and dry tropics and subtropics are already populated beyond their capacity for food production. In Africa, for example, only about a quarter of potential rainfed cropland in the humid tropics is cultivated, while three other swathes of the continent have already surpassed population-carrying capacity at low input levels. Even using the highest-level farming technology, four African countries would remain critical: Cape Verde, Mauritius, Rwanda, and Western Sahara.

The Future Most Critical Areas

One difficulty in trying to identify potentially critical situations on the basis of global or regional food balance data is that deficits in some countries tend to cancel out surpluses in others. To determine how much international trade—or food aid—would be required to alleviate food shortages, it is more useful to look at aggregate surpluses and deficits in re-

gional or subregional terms.

A recent study estimates that by the end of the century 22 developing countries self-sufficient in food staples could have as much as 118 million tons surplus production. This compares with a mere 25 million tons of surplus production in 1980 and would represent an annual increase of about 8 percent. The other side of this coin is that no less than 83 food-deficit developing countries are projected to post a collective shortfall of 185 million tons annually by the end of this century, about two and a half times the total shortfall occurring in food-deficit countries in 1980.

Countries projected to produce surpluses are located in all developing regions, but more than two-thirds of the total surpluses would be accounted for by Asian nations, notably in South Asia, which is projected to produce a gross surplus of 20 million tons, and China, which has already shifted from food-deficient and will go to surplus status. Surplus production in the cone countries of South America—Argentina, Chile, and Uruguay—would be the major factor in the Latin American region's contribution of about 30 percent to the global gross surplus. A handful of countries in central, eastern, and southern Africa would account for most of the remaining surplus.

On the deficit side, the North African/Middle East region would account for the largest gross shortfall, about one-third of the total, with sub-Saharan Africa close behind at 30 percent. On a subregional basis, the largest shortfall, accounting for almost 20 percent of the total, would occur in West Africa.[37]

Dynamics of the Food/Population Interaction

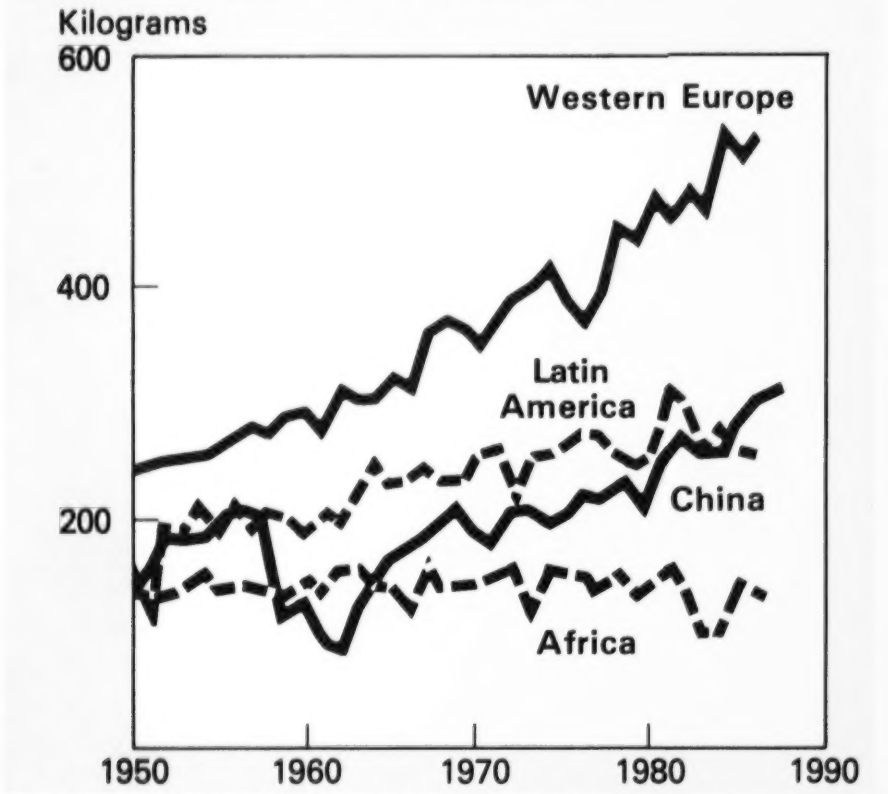
Studies of the potential carrying capacity of different regions, countries, or zones can help to identify the localities and populations most vulnerable to critical food shortages. However, they provide little guidance concerning the interaction between population growth, the utilization of resources for food production, and trends in nutritional status. This is a critical point, since much of the hope for the eventual stabilization of population rests on the assumption that population growth rates will decline as living standards, including nutrition, improve.

But the dynamics of the food/population equation are conditioned by many factors. Undoubtedly, population density within a given area is one determinant of land use. Much concern has been expressed about the environmental impact of mounting population pressures. Yet decisions about family size and about what food is to be produced or acquired with the resources available are made, after all, at the household level and are shaped by individual perceptions and values. The distribution and mobility of population may affect not only the amount of food produced, but the kind of food as well. There is considerable evidence that the process of urbanization is generally accompanied by declining birth rates and by changes in food consumption habits that in turn influence demand for staple foods.

Population Pressure and the Environment

One starting point for much discussion on the impact of population growth is the accumulated evidence of environmental degradation traceable to increasing population densities. The basic contention here is that rapid population growth not only reduces available per capita dietary energy from available food supplies, but also threatens the sustainability of existing levels of food production. "A frustrating paradox is emerging," notes Lester R. Brown and Sandra Postel. "Efforts to improve living standards are themselves beginning to threaten the health of the global economy. The very notion of progress begs

Figure 7. Per Capita Grain Production: 1950-1985



Source: *State of The World 1985* and *State of The World 1987*, copyright Worldwatch Institute.

for redefinition in the light of the intolerable consequences unfolding as a result of its pursuit."[38]

In 1970, Africa as well as China and India produced approximately 180 kilograms of grain per capita per year. African production has since fallen by one-fifth, as shown in Figure 7. "Eroded soils and poorly nourished crops inevitably lead to poorly nourished people."[39]

Specific instances of environmental degradation in areas of rapid population increase are not lacking. Of the billion and a half hectares presently growing crops around the globe, nearly two-thirds have been brought into cultivation since the middle of the 19th century, with a corresponding reduction in a variety of natural ecosystems: grasslands, wetlands, temperate and tropical forests.[40] As much as 50 percent of the world's wetlands may already have been lost.

As population pressures have pushed cultivation from plains and valleys into the hills, an estimated 160 million hectares of upland watersheds in tropical developing countries have been seri-

ously eroded. The World Bank has estimated that under these circumstances an average of 50 tons of topsoil per hectare is lost each year. An FAO study reported that tropical trees were being cut much faster than nature or man could replace the trees. Tropical forests in Central America have been reduced by 38 percent and in Africa by 23 percent in a little over a quarter-century.[41] Deforested areas are more subject to erosion: as the trees that anchor the soil disappear, wind and rain can pick up more soil faster. Runoff means that much of this soil ends up silting and polluting water resources. Trees also absorb carbon dioxide and give off oxygen, offsetting the "greenhouse effect" warming the earth, and have other strong impacts on global and local climates.

On the densely populated island of Java, whose 7 percent of the total national land surface contains 60 percent of Indonesia's population (fifth largest in the world), soil erosion rates range from 3 to more than 20 times greater than in other parts of the country and sediment concentration in the river basins is from 2 to 10 times as great.[42]

In Nigeria, there are reports of increasing conflicts between Fulani pastoralists and sedentary Hausa farmers as growing populations prompt both groups to encroach into the semi-arid zone above the 15th latitude that the government has been trying to protect from settlement and over-grazing.[43]

However, there is a danger of oversimplifying the complex relationships between human populations and nature by attempting to draw general conclusions from specific instances.

The late Rafael M. Salas, former head of the UN Fund for Population Activities, maintained that there is no need to prove particular instances of environmental pollution, natural resource depletion, or climatic change in order to prove that rapid population growth disrupts the balance between nature and man. Instead, he based his argument on the principle of entropy of Nicholas Georgescu-Roegen: "the irrevocable degradation of free energy into bound energy."[44]

Salas cites deforestation as an illustration: "the consequence of the need for more agricultural land and for firewood and charcoal as a source of energy; both are intimately linked to population growth."[45] He noted that population growth was only one factor in the deforestation process; inappropriate technologies, ill-defined property rights, poor management of resources, and poverty also contributed. Well over half of global roundwood production is now used for firewood or charcoal, compared with slightly more than 40 percent 30 years ago.

Jodha maintains that the highest risk of permanent ecological degradation from rising population pressure falls in dry tropical regions where most inhabitants still subsist on traditional agriculture. Not only is productivity low; the process of recovery from damage to natural resources is slow.[46]

Continued degradation of the soil may often be a matter of the lack of incentives to cultivators to undertake the necessary corrective action. As population densities increase, cultivated areas tend to expand outward—and upward—from more productive lowlands into the thinner soils of uplands previously utilized for pasture or covered with forest. Lower returns from these fields discourage investments in needed conservation measures, such as check dams or terracing. The situation is often exacerbated by another symptom of population pressure, land fragmentation, which renders coordinated conservation activities more difficult, even within a single watershed.

In these situations there is clearly a potential role for some catalyst to induce an effective cooperative effort. The problem in many poor countries is that the pump-priming action that might be expected through government intervention is ruled out because public funds are thinly spread to provide services and employment for expanding urban populations.

Impact of Urbanization

In many parts of the developing world, rapid urbanization has been the major social change of recent decades, with consequent changes in food consumption habits and implications for nutrition both in rural and urban areas. One notable trend, especially in Africa and Latin America, has been a declining demand for traditional cereals, roots, and tubers grown locally. Meanwhile, rice and wheat have surged in popularity as urban populations in developing countries have become more familiar with dietary patterns in the industrialized world.[47] Consumption surveys have found that in Tunisia, for example, the traditional staples of hard wheat and barley are yielding place in urban diets to industrially processed cereals, livestock products, and vegetables. In Brazil, a similar shift from the traditional diet of maize and rice is underway.

Food consumption patterns among rural populations are also changing, at least partly as a result of the processes of urbanization. Since many of those who migrate to cities in search of better employment opportunities are at the most active stage of life, populations remaining in rural areas reflect a much higher ratio of dependents—the very young and the elderly—who are directly supported by those of working age. In Africa and the Far East, this "dependency ratio" has increased two- or three-fold in rural areas. If families remaining in the villages receive cash remittances from family members working in the city, they may imitate the dietary patterns of the urban migrants, consuming more tea, bread, biscuits, and soft drinks. And if remittances are not forthcoming, these poor households, and especially children, are much more vulnerable to severe malnutrition. The incidence of severe malnutrition was 6 times higher in Zimbabwean rural families if absent workers did not send remittances home than if remittances were received.[48]

As farmers have begun to specialize in new crops in response to changes in urban food demand, the variety of food produced in local areas has declined, adversely affecting the diets of the rural poor.

World Bank/Peter Muncie

Vegetable sellers in Ubon, Thailand.

The overall economic impact of continuous out-migration from rural areas towards cities is extremely difficult to predict or evaluate. Few real-life situations prove to be as tidy as economists' computer models. In theory, siphoning off surplus labor from the countryside should increase the amount of land and capital available for each agricultural worker, consequently improving productivity and narrowing the gap between rural and urban incomes. Such assumptions, however, ignore other factors. Often it is the more productive members of the rural work force who migrate, so that the output of those left behind to tend crops and herds may actually decline on a per capita basis. Agricultural output may also be influenced if the families of the migrant workers receive regular re-

mittances from new urban sources of income.

Migration patterns in Brazil during the past four decades afford some insights into the interaction between population growth, food production, and nutrition. In the 35 years between 1950 and 1985, the proportion of Brazilians living in rural areas declined from two-thirds to one-quarter of the national population. By the 1970s, the rural population was also dropping in absolute terms, a decline that has now reached the rate of 1.3 percent per year, aided by lower fertility rates among rural women (5.8 children per woman, compared with 7.7 children per woman in 1950, and with the present urban average of 3.5).[49]

During this same period, the cultivated area in Brazil grew by more than two and one half times, from 19 million hectares in 1950 to 49 million in 1980. The availability of these ample land reserves, however, has had little effect in checking the flow of migration toward the cities. For low-income families, the high initial costs of developing virgin land has made the admittedly difficult life on the urban fringes appear as the better prospect for survival.

In Brazil, as in other Latin American countries, the trends toward industrialization and urbanization are clearly affecting fertility and population growth. However, many argue that the social costs of this process are too high. It has been estimated that in most Latin American countries marginalized workers now comprise nearly half of the total work force. Their desperate daily struggle for survival may have as much to do with modifying fertility patterns as any formal institutional arrangements.[50]

In Kenya, which has one of the world's highest rates of natural increase (births minus deaths), a remarkably different pattern of relationships in rural-urban migration has been detected. In the early 1970s, some experts concluded that the country's exceptionally rapid population growth combined with the continuing movement of large numbers of people into Nairobi would result in serious unemployment and the attendant economic and social problems. But a subsequent study, nearly a decade later, found the socioeconomic situation much better than might have been expected on the basis of the earlier forecast. Although Kenya lacked a rapidly developing industrial sector to absorb surplus rural labor, it became evident that the agrarian economy possessed a much greater capacity to provide employment than had been previously imagined. A major factor, evidently, has been the trend toward fragmentation of farm holdings. In the great majority of districts, holdings are now estimated to average less than half a hectare per person. There is evidence that more intensive use of labor on the smaller plots yields significant gains in productivity. It was found that income per worker on holdings of less than two hectares was only marginally less than that on larger holdings. And in some districts, a growing number of smallholders have shifted to production of higher value crops, such as tea and coffee, that demand labor-intensive cultivation.[51]

Access to Food

While it is generally accepted that increased income has been the dominant element in improving dietary standards, the broader concept of household viability developed by Ian Livingstone may be more useful in planning programs to aid the poor. This combines such elements as the capacity to earn particular levels of income, the production resources available to a household, diversity of income sources, and food adequacy and security. This kind of survival strategy at the micro-level helps to offset a frequently overlooked problem: the fact that incomes and levels of food production are often even more unstable at the household level than within countries. The income and spending history of 4,000 rural households surveyed in India revealed that almost half of them had experienced at least one year in which per

capita income dropped more than 30 percent below their three-year average. Yet Indian food production and aggregate income remained stable during that time period. [52]

"Problems of the rural poor . . . cannot be solved simply by augmenting agricultural production," comments Vijay S. Vyas of the World Bank. "The diversification of the rural economy is the major challenge and that would not come automatically. It is reasonable to assert that without conscious decisions to encourage non-farm activities, the large bulk of rural people cannot be provided with opportunities for gainful employment and income and access to food."[53]

The approach adopted by the governments of many developing countries—a mixture of aid, trade, and exchange rate policies designed to maintain low domestic food prices—has recently been under severe attack on the grounds that it has acted as a deterring disincentive, thus jeopardizing the development of a major sector of the economy and ultimately frustrating efforts to attain national food security.

The World Bank, however, points out that the effects of lower food prices, in the short run at least, will depend to a great extent on patterns of income and resource distribution within a country. If a large proportion of the poor are subsistence farmers, largely outside the monetized economy, changes in food prices will have little effect on food security. On the other hand, in cases where considerable surpluses of food are produced by the rural poor, policies designed to keep food prices low will undoubtedly erode longer-term food security. Where there are large populations both of urban poor and landless rural workers, lower food prices are likely to benefit overall food security. "It should not be presumed that only the urban poor benefit from lower food prices and that the rural poor are always better off with higher prices," the Bank study declares. "In fact, there is considerable evidence to the contrary."[54]

Protecting the Resource Base

Short-term vs. Long-term Tradeoffs

For more than three decades the central focus of most agricultural research has been on increasing productivity to match contemporary market requirements in terms of prices and quantities. In the industrialized world, in particular, this implied an emphasis on labor-saving, yield-increasing technologies. Mechanization, soil fertility enhanced with chemical fertilizers, and controlling diseases and pests with pesticides and pharmaceuticals provided the basis for modern agricultural industries that permitted 10 percent or less of the population to provide most of the food required by the other 90 percent. Dramatic increases in output both for units of labor and of land provided the justification for greater dependence on external inputs and for assuming the associated costs and risks. As international efforts were mounted to confront the problems of low agricultural productivity in the developing world, it was not surprising that some of these external inputs, most notably from the agro-chemical industry, should be combined with newly developed, higher-yielding varieties of major food crops to provide the package of technologies that was to be dubbed "the Green Revolution."

The success of such countries as India and Pakistan in rapidly increasing domestic food production, removing the perpetual threat of famine in the course of a few years, gave additional credibility to modern agricultural technology. It fostered the short-lived illusion that solutions to the global problems of hunger and undernutrition were at hand.

Unfortunately, the illusion was founded on several ill-considered assumptions that were quickly to be demolished by a series of natural and political events. First, the economics of modern agricul-

Severe erosion, U.S.A. FAO/U.S. Soil Conservation Service

ture was based on relatively low prices for the petroleum-based energy needed to produce fertilizers and to fuel tractors and irrigation pumps. With the newly discovered ability of oil-exporting nations to establish, collectively, much higher price levels, the economics of energy-intensive agriculture was drastically revised.

A second weakness inherent in the system was the failure to anticipate the environmental impact, both in the near and the longer term, of heavy reliance on chemical inputs. Beginning with Rachel Carson's seminal "Silent Spring" in 1962, a growing body of literature documented the environmental and health hazards likely to arise from agricultural systems that depended too heavily on chemical inputs. The ensuing debate most often engaged fervent defenders of the environment against equally devoted proponents of modern farming convinced of the need to maximize production in the face of expanding world population. This tended to obscure other considerations far more pertinent in influencing the decisions of producers as to the type of technology they might employ. Even while farmers in the developing world were still learning how chemical inputs could boost yields and reduce losses from diseases and pests, practitioners of high-technology agriculture were discovering that even without calculating environmental damage, cost-benefit ratios of chemical-dependent agriculture tended to become less favorable as many species of pests developed resistance to chemicals prescribed for their control.[55] Finally, reflecting some of the urgency with which the early stages of Green Revolution technology were advanced, the international research effort initially focused mainly on major crops, on more favored lands, and on the larger producers. Those dependent on rainfed agriculture rather than irrigated lands and smallholders producing traditional mixtures of crops on marginal land benefited little, if at all, from the diffusion of these new technologies.

What has evolved gradually with recognition of these facts is support in the

mainstream of the agricultural community for the development of farming systems less injurious to the environment and more concerned with the protection of the resource base for generations to come. "In my view," says Kenneth R. Farrell, former Director of the National Center for Food and Agricultural Policy at Resources for the Future, Washington, D.C., "our policies have been strong incentives to producers to employ technologies that sometimes have adverse environmental effects, the reason being that we have tried to limit production by controlling land input; farmers naturally then use more of the less scarce resources—fertilizers, pesticides, and many other kinds of chemicals. We must learn to think about technology in the broader context of the institutions, the policies, and the economic environment in which technological development occurs."[56]

More than a quarter of the United States cropland is subject to soil erosion in excess of the level that would permit present crop yields to be maintained indefinitely. If foreign demand for U.S. farm products continues and there are no major developments in technology, upwards of 50 million acres of additional cropland, much of it of marginal quality, may be brought into cultivation within the next 20 years, greatly increasing risks of widespread erosion and reducing overall agricultural productivity.[57] Water is another resource which U.S. agriculture has squandered under the influence of low energy costs and publicly-subsidized water rates. It is estimated that nearly a quarter of the groundwater used by agriculture is not replenished.

The picture is equally disturbing on a worldwide basis. In India, some 80 million hectares of cropland are seriously affected by soil erosion. Another 60 million hectares are at risk in China's loess plateau region. Ethiopia's central highland plateau has 47 million hectares seriously eroded, with nearly as much in Madagascar. The entire land surface is affected in the mountainous countries of Nepal and Peru.[58]

Environmental groups are stressing the economic side of their argument. "Far from being a merely protectionist science," writes Ignacy Sachs, Director of the International Center for Research on Development and the Environment in Paris, France, "ecology also raises a very decisive call to productivity. In fact, ecology embodies a philosophy of resource management in sharp contrast to that strict productivity which simply loots nature. ... Ecology seeks a productivity that is sustained by ecosystems. To define ecodevelopment, we start once again from a peasant rationale, but one completely open to the achievements of modern science."[59]

Unfortunately, recognition of the significance and value of many traditional peasant farming practices has been delayed by long-cherished prejudices among agricultural scientists against what was considered "primitive" technology. However, growing interest in biological approaches to agriculture have led researchers to examine many traditional practices more closely. While it is clear that there are definite agronomic limits in traditional farming systems, it is equally true that the survival of many age-old practices reflect an acquired expertise in husbanding all available resources to sustain food production in the face of hostile and unpredictable environments. As population densities have increased, traditional systems have often been pushed beyond their capacities, with disastrous results. Yet the element of permanence that was fundamental to most of these systems suggests a principle that might well be embraced by modern, "high-tech" agriculture. "The challenge for agricultural research is to improve agriculture in ways that retain the strengths of traditional agriculture while meeting the needs of changing times," declares Gerald Marten of the East-West Center in Hawaii.[60]

Prospects for Continuing Increases

The possibility that agricultural science is

indeed on the threshold of new advances that could relieve some of the pressures on food production resources receives increasing attention.[61] Some of the fields in which biotechnology applications could provide major breakthroughs in agricultural research were identified in a recent report prepared for the International Rice Research Institute (IRRI) at Los Baños in the Philippines.[62] These included:

- breeding for increased biomass;
- breeding for protein quantity and quality;
- breeding for disease resistance;
- identifying bacterial, fungal, and viral strains;
- selecting for tolerance against soil salinity, drought, aluminum toxicity;
- increasing genetic variability and inducing novel variability by producing hybrids;
- incorporating nitrogen-fixing genes into cereals;
- developing clones for propagation of horticultural and forest species, including some vegetable crop plants;
- *in vitro* fertilization of flowering and hybrid production for breeding tree crops;
- preserving germplasm of asexually-reproducing species.

One critical consideration, of course, is whether new advances in biotechnology will be readily accessible to benefit the great majority of agricultural producers. Kenneth Farrell has expressed concern that there may be proprietary rights associated with these new technologies that would restrict their distribution. In the United States, he points out, a growing proportion of total agricultural research resources are now coming from the private sector, either through research that companies conduct in their own laboratories or research they support in universities.[63]

Peter Söderbaum, who specializes in the economics of natural resources at the Swedish University of Agricultural Sciences at Uppsala, has proposed a number of what he terms "ecological imperatives for public policy" which would avoid

FAO/Jack Ling

Terracing and irrigation for rice-growing has been underway for some 4,000 years in Luzon Province, the Philippines.

negative long-term impacts on living conditions not only within the region immediately concerned, but externally and globally as well.[64]

Robert Rodale, of the organic farming center and publishing house in Emmaus, Pennsylvania, contends that the rapid expansion of external inputs over the past century has unnecessarily diminished the usefulness of the internal resources of agriculture and that, on a worldwide basis, the external inputs have become too costly. As an alternative approach, he argues the case for a "regenerative" agriculture. He believes it is important to understand the natural regenerative capacity of the internal resources of agriculture and to encourage farmers to make better use of these methods.[65] Judging from surveys carried out by the Rodale Research Center, a growing number of U.S. farmers are becoming involved or interested in organic farming practices that would reduce dependence on external inputs.

Some developing countries have also demonstrated that the process of soil degradation can be reversed. Possibly the most outstanding program is in Kenya where, under a national soil conservation campaign supported by Swedish aid, about 40 percent of the country's 900,000 farms have been terraced over the past decade. Besides ending serious soil erosion, the program has brought significant economic benefits. Maize yields on terraced lands have been 60 to 100 percent higher than those grown with traditional practices. Bean yields have been 80 to 130 percent higher. Overall, it has been calculated that returns to labor on terraced land are at least 40 percent higher than for unterraced land.[66]

There are many regions of the world, however, where similar funding for soil conservation campaigns is not available and where farmers may be reluctant to undertake the required investments because they do not foresee the returns, at least in the short run, justifying the outlay. In 1981, the member governments of the Food and Agriculture Organization adopted a World Soil Charter advocating research and education programs in soil and water conservation and the provision of institutional and economic incentives for adoption of appropriate practices. But implementation faces many constraints. Effective soil conservation programs are long-term propositions, implying commitments that many governments are unable or unwilling to make in the face of competing demands on limited budget resources. Again, hierarchical government bureaucracies are often ill-adapted and their extension personnel inadequately trained for mounting the kind of campaign that will enlist the support of farmers. In many developing countries the whole concept of soil conservation is in disfavor because of previous attempts by colonial regimes to enforce conservation practices through legislation.[67]

Food Security

Chronic undernutrition and even famine are not necessarily related directly to levels of food stocks or to population densities. In fact, as Amartya Sen has pointed out, even in the 18th century such classical economists as David Ricardo and Adam Smith acknowledged that famine might occur among the poor and unemployed unable to acquire food even in the midst of an abundance of foodstuffs.[68] (Table 3 shows food prices relative to income and energy content.) Their clear message is that free market mechanisms do not respond to those unable to "signal" their need in economic

Table 3. Price of Food Relative to Income and Energy Content of Diet

1975
(United States = 100)

Countries classified by per capita income	29 developed and developing countries			17 developing countries		
	Mean income	Mean energy content of diet	Mean relative price of food	Mean income	Mean energy content of diet	Mean relative price of food
Lowest third	12	63	172	8	60	209
Middle third	39	82	137	20	70	125
Highest third	74	101	105	31	81	151

Note: The developed countries included in the analysis are: Austria, Belgium-Luxembourg, Denmark, France, Germany, Ireland, Italy, Japan, Netherlands, Spain, United Kingdom, and the United States. The developing countries included in the analysis are: Brazil, Colombia, India, Iran, Jamaica, Kenya, Korea, Malawi, Malaysia, Mexico, Pakistan, Philippines, Sri Lanka, Syria, Thailand, Uruguay, and Zambia

Source: World Bank

terms, including the need to meet nutritional requirements. Increasing food production is no guarantee that food prices will decline sufficiently to enable all or any of the destitute to enter the marketplace; it may only result in lowered incomes for food producers.

"The first cause of hunger and malnutrition is poverty." This was the resolution adopted by the International Conference on Food and Agriculture at Hot Springs, Virginia in 1943. This meeting and its remarkable document led to the founding of the UN Food and Agriculture Organization at Quebec City, Canada two years later, setting the framework for the first cooperative international effort to eliminate hunger.

International Aspects

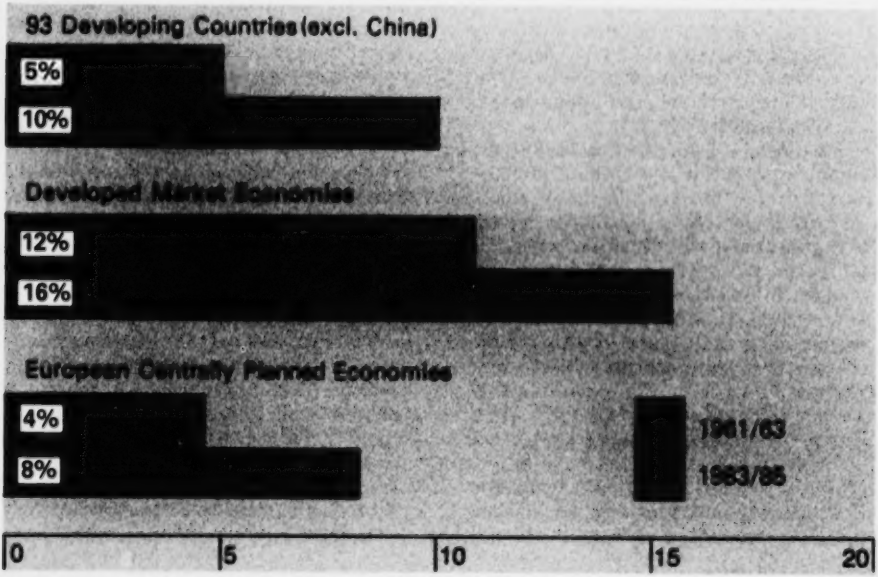
The progress that has been achieved since then, in terms of increasing food production, has been exceptional, but the fundamental goal, food security for all, has been elusive. Although major food commodities, on a global basis, have been in surplus far more often than in short supply over the intervening years, both poor countries and poor households have been reduced to accepting handouts if available, or doing without. In several cases, notably Bangladesh, Ethiopia, and the African countries of the Sahel in 1973-74 and Ethiopia and some other African countries again a decade later, widespread famine has resulted. (The Sahelian countries bordering the Sahara are Burkina Faso, Cape Verde, Chad, Gambia, Guinea-Bissau, Mali, Mauritania, Niger, and Senegal.) Despite more than four decades of international efforts, no fully effective means for ensuring food security for everyone has yet been devised.

A reading of the history of the governing bodies of FAO and related international food agencies offers some insight into the difficulties involved. From their earliest deliberations, the issue of supranational intervention in food distribution systems has posed a controversial, intractable problem. Within a year of its founding, FAO's first Director General, Sir John Boyd Orr, had proposed the establishment of a World Food Board that would set floor and ceiling prices on major food commodities, ensuring price stability by buying and selling as necessary, diverting surpluses of basic foodstuffs to the poor at subsidized prices, and establishing a world food reserve of sufficient size to compensate for crop failures in any region. It soon became evident, however, that proposals of this type were not welcomed by most member nations. Advances that were made in institutional arrangements over subsequent decades reflected more of a piecemeal approach to the resolution of global food problems.[69]

One of the first problems to be tackled in this manner was the matter of the huge commodity surpluses that began to accumulate in some of the major developed agricultural exporting nations in the early 1950s. Soon after the United States launched its bilateral food aid program in 1954, pressure began to mount for a multilateral program that would utilize donated food surpluses as support for development projects, as well as in emergencies. This eventually led to the establishment of the UN/FAO World Food Program in 1963.

Critical food shortages in the early 1970s gave impetus to renewed efforts to develop stronger international mechanisms for guaranteeing food security. The UN World Food Conference in Rome in 1974 provided a central focus not only for the immediate crisis affecting Bangladesh, Ethiopia, and the Sahel, but also for the longer-term development of agriculture and improvement of nutrition. Along with the two other preceding mega-conferences—the UN Conference on the Environment in Stockholm in 1972 and the World Population Conference in Bucharest in 1974—the Food conference helped to create a much greater awareness of the many factors influencing the course of economic development. But in terms of concrete action to enhance

Figure 8. Food Imports As Percentage of Total Food Supplies



Source: FAO

world food security, the achievements at the Conference were modest, at best. Participants did endorse an international undertaking for world food security that had been proposed by FAO's then Director General, Addeke H. Boerma, and eventually some 75 countries and the European Community agreed to adhere to its principles. This did lead to the establishment of a couple of useful new mechanisms administered by FAO: a global information system to provide earlier intelligence on potential crop failures and food shortages—satellite and computer-based—and a food security assistance scheme to aid member countries in setting up reserve food stocks. However, what was to have been the cornerstone of the undertaking, an internationally coordinated system of nationally-held food reserves, became hostage to the moribund negotiations for an International Grains Arrangement. Boerma's successor at FAO, Edouard Saouma, has endeavored to keep the food security concept alive with a proposed action plan calling for unilateral adoption of national policies on food grain stocks in accordance with the undertaking, and with a World Food Security Compact, designed to symbolize the moral—though not legal—commitment of governments, organizations, and individuals to world food security.

Thus, although certain elements have been introduced to facilitate the response of the international community to critical food shortages, the situation for low-income, food deficient countries remains essentially as it was a generation ago. In the case of critical food shortages that these countries are unable to overcome through purchases on the commercial market, they may launch an appeal for international assistance. Usually, aid has been forthcoming; often, it has been generous. But logistics and timing under these circumstances do not always per-

mit its most effective use. The ultimate result is that food-deficit countries cannot always rely with certainty on international mechanisms for effective assistance when there are critical shortfalls in their food supply. Their most obvious alternative is to fashion domestic policies that will foster self-reliance in food supplies, if not self-sufficiency, to the greatest possible extent.

In some quarters, however, there are strong doubts about the desirability or feasibility of pursuing the food self-sufficiency target to the exclusion of all other interests. The World Bank, for one, has warned that "National self-sufficiency in tradable foods is efficient only when a country has a comparative advantage in producing those foods. Moreover, food security is achieved only if all households have the ability to buy this food. Thus there is no necessary link between selfsufficiency and food security."[70] To support this contention, the Bank's study cites analyses of food security data from 50 developing countries which indicate that variations in self-sufficiency in cereals appear to have little correlation with the energy-intake levels of the national diet.

National Interventions

Regrettably, finding the right policy mix that would both provide incentives for the expansion of domestic food production and meet consumer demand for low-cost food has not proven easy for many Third World governments. To a considerable degree, they have opted for a variety of trade, aid, and exchange rate policies that have kept domestic food prices low and generally resulted in underinvestment in food production. Increasingly, such policies have come under attack, especially from international financial institutions, and a considerable number of developing countries have recently begun to introduce adjustments.

However, the difficulties that many developing countries face under present economic circumstances can be fairly gauged from the situation in some debt-burdened countries in Latin America. Under close scrutiny from the international financial institutions, many Latin American governments have been searching for ways to refinance their monumental debts, including the restriction of demand, the reduction of government intervention in the economy, the liberalization of prices, and the promotion of exports. In the view of some observers, these new policies introduced to meet conditions imposed by the international financial agencies, appear likely to result in further deterioration of conditions for the lowest income groups in the population.[71] The effect of heavy indebtedness on national food security objectives is difficult to quantify since the full impact is neither direct nor immediate. However, it seems clear that in some 60 countries, identified by the International Monetary Fund as having problems with indebtedness, growth of domestic demand for agricultural products was checked during the period 1981-85 due to increasing unemployment and declining per capita Gross National Product. Tight budgets have resulted in reduced food subsidies and drops in government expenditures for agricultural development.

Properly functioning markets—for labor and capital as well as for goods—are now regarded as a key mechanism in effecting the economic adjustments required by a rapidly growing—and shifting—population. By registering the initial impact of population growth in the form of price changes, a properly functioning market can touch off a variety of adjustments, introducing new factors of production made more valuable by population growth, reallocating resources towards the most responsive sectors, and intensifying research for substitute products and processes.[72]

But while the lack of good markets has been cited as a contributing factor in numerous food crises, most notably in African countries, they do not necessarily guarantee access to food by a household

or an individual. Transportation, storage, and distribution networks are also important. Government policies clearly play an important role. In a market economy, individuals or families, unless they have direct access to food by producing it themselves, must have enough income-generating employment to afford an adequate diet.

Legislation and policies established by national governments unquestionably have a marked influence on the household economy and on individual choices. But the development of a modern, centralized administration does not preclude the survival of traditional, less formal, institutional arrangements. Detailed research among some Sahelian societies, for instance, has discovered a remarkable degree of diversity and flexibility in the ways in which local communities respond to the stress of food scarcity. What seems clear from these findings is that no single, central policy is likely to fit conveniently with all of the wide range of responses that are evoked by crisis situations. Among the Bambara people, for example, traditional households comprising the families of several men who share a common ancestry may live and work together through several generations, providing a sense of continuity and solidarity. While migration, especially of younger men, is one response to stress, it is not suggested that deliberate policies of induced or planned migration would be likely to work with this African culture.[73]

Population Policy Initiatives

Amid the continuing concern about our planet's capability to sustain ever larger populations, it is easy to lose sight of the remarkable progress achieved within the past four decades in efforts to slow the rate of population increase. India became the first nation in the world to introduce a national family planning program, in 1950: since then, nearly two out of three developing countries, including many of the most populous, have adopted official family planning programs. It is estimated that developing countries spend about $2 billion annually on population or family planning programs, one-quarter of which comes from external assistance programs. While there are enormous variations in both the extent and effectiveness of these programs, there is clear evidence that they have, in general, brought about a reduction in total fertility rates. The number of lifetime births per woman in the developing world as a whole declined from about 6 births per woman in the late 1960s to 3.6 in the mid-1980s. There are, of course, significant regional differences in these trends. The sharpest change (a drop to 2.3) has been registered in East Asia, while there has been only a negligible decline in Africa. If China is excluded, the overall fertility level is 4.8 births per woman in developing countries as of 1987.

The declines in fertility over this period show a distinct correlation to the prevalence of contraceptive use.[74] Contraception has increased in every developing region in the past two decades, attaining a prevalence estimated at 38 percent, or slightly more than half of that of the industrialized world. But regional differences in utilization are dramatic, ranging from a low of 11 percent in Africa to a high of 69 percent in East Asia. The African countries surveyed with contraceptive prevalence rates below 20 percent have total fertility rates in excess of 6 children per woman. Analysis of the relation between contraceptive prevalence and total fertility rates demonstrates clearly that contraceptive use is the key determinant in fertility trends, although there are sufficient deviations from the norm to suggest that other determinants, both positive and negative, are also involved.

There is, of course, considerable debate as to whether the use of contraception and the consequent decline in fertility should be attributed to official family planning programs or to economic development in general. While it may be

World Bank

Family planning campaign in Kenya where a national increase of 3.9 percent annually means the population will double in 18 years.

difficult to ascribe precise weighting to the various determinants of contraceptive use, recent analysis indicates that the degree of commitment and effort shown by governments in family planning programs has significant correlation with the use of contraception regardless of the level of economic development.[75]

The development of population programs plus trends in the use of contraceptives have paralleled, and most probably reflect, changing policy approaches of many governments on population issues. This evolution is readily apparent from a comparison of the 1984 UN World Population Conference in Mexico City with the one held 10 years earlier in Bucharest. The set of 88 recommendations adopted at Mexico City gave strong support to the principle that population policies and programs are integral elements of economic development. This was in contrast to a widespread attitude among representatives of developing countries at Bucharest that, at best, family planning programs were less effective than economic development in reducing fertility, and, at worst, reflected a conspiracy of Caucasoid peoples in industrialized countries to contain the growth and influence of non-white populations.

Ironically, it was at the Mexico City conference that the United States, the major donor for external assistance to population programs, signaled a pronounced policy shift. In addition to its opposition to abortion, the U.S. argued that the rate of population growth was essentially a neutral factor in economic development and that economic growth fostered by free market policies held the greatest potential for a voluntary reduction in fertility rates. On the one hand, it has been noted that the U.S. stance may have made it easier, in a purely political sense, for some anti-American countries

to openly endorse family planning policies. On the other hand, the American refusal to support organizations or programs promoting or condoning abortion or what the U.S. perceives to be coercive population control, has had serious implications for population program funding.[76] There have been more recent indications of a resurgence of opposition to family planning policies from other sources, such as conservative Catholic groups in Latin America and the Philippines, Moslem fundamentalists in the Middle East, and nationalist groups in a number of industrialized countries. As a consequence, prospects for both external funding and domestic support for population programs, even now calculated at only about 1 percent of development assistance and national budgetary expenditures, are not improving.

In these circumstances there is a clear rationale for governments and planners to ensure that population policies are carefully integrated within the overall cultural and economic framework of their respective countries. Few societies are likely to be able to mount the type of campaign through which China, with an outlay of about $1 per person annually, has been able to increase the use of contraceptives and reduce total fertility from 6 to 3 births per woman within the space of a decade. China, it should be recognized, has a tightly-controlled economic and social structure highly susceptible to the government's goals; an intricate system for the allocation of work points that rewarded families with few dependents; and a highly organized rural society that does not permit demographic costs to be shifted outside the community, thereby increasing pressures for conformity in matters of family size.

Yet even countries confronted with major cultural barriers to family planning have shown that progress in reducing total fertility is possible. In Bangladesh, where a traditional patriarchal system has restricted the opportunities for women to have any independence and conformity to social norms implies high fertility rates, a woman's cooperative project, operating for the past 14 years, has demonstrated how activities designed to enhance economic opportunities can be linked to a family planning campaign.[77] With an outlay less than $2.5 million during the period 1980-85, the project has been able to cover more than 20 percent of the nation's 473 administrative units, reaching some 1,700 cooperatives with a total membership of 67,000. While the more immediate activities of the program concentrate on the provision of credit and training needed for self-help, income-generating activities, the longer-term objective is to bring about fundamental changes in the lives of rural women, including the concept that women can be responsible for decisions about the desirable number of children. Some indication of the impact being achieved may be taken from the results of a 1983 survey indicating that about two-thirds of all cooperative members had accepted family planning practices, compared with about half that level in family planning projects lacking an economic component, and an 11 percent level nationwide.

Even in Africa, where population programs have made the least progress and where high fertility rates and cultural barriers to family planning are reflected in rapid population increase, one country has demonstrated that family planning concepts, carefully tailored to the cultural environment, can take root in a relatively short space of time. Superficially, at least, Zimbabwe would not appear to be a likely candidate for this role. During the struggle for independence from colonial rule, the liberation movement regarded white-operated family planning services as a racist conspiracy to limit the black population. But once independence was gained, the new government was quick to recognize the close links between family planning and health and almost immediately launched an "Africanization" of the existing programs.[78] Rather than trying to introduce alien concepts of small families, the Zimbabwe program has empha-

sized the spacing of children and the health of both mother and child, concepts already inherent in African culture. Backed by a strong promotional effort through radio, schools, and exhibitions, and supported by 150 clinics or hospitals and more than 500 community workers, the program is credited with achieving the highest level of contraceptive use in Africa, 38 percent of all women of childbearing age.

Experiences such as those in Bangladesh and Zimbabwe lend credibility to the argument that population policies and programs ought to be designed within the general framework of economic and social planning, rather than viewed as an end in themselves with an isolated and independent impact on national well-being.

Improving the Bottom Line

"Reduction of fertility in and of itself will not cause poor nations to become rich," the final report of the 71st American Assembly on International Population Policy concluded. "But it can provide time and relieve pressure on societies to direct resources toward satisfying the minimum needs of a rapidly growing and economically dependent population." Lower population growth rates could ease constraints on human and capital formation, help to balance employment opportunities and the labor force, reduce pressures on public services and institutions, and foster more equitable distribution of income and opportunities.[79]

Authorities in developing countries, however, face a variety of constraints: cultural or religious sensitivities, limited resources and expertise, and a global economic climate that severely restricts their options for remedial action. Two fields in particular—the generation of employment and protection of the environment—will serve to illustrate their frustrations.

One of the major challenges confronting developing countries with high population growth rates is to find some means of shifting surplus rural labor into nonagricultural pursuits. The prospective benefits of such a shift would be to reduce per capita income disparities between agricultural and nonagricultural workers as well as to provide, in theory at least, an expanding commercial market for agricultural products. Many developing countries have sought to foster the process of industrialization by providing protective measures that have tended to favor the industrial sector at the expense of agriculture. Unfortunately, the industrialization strategies have often tended toward capital-intensive production, thus limiting opportunities for off-farm employment.

As the fragmentation of holdings and landlessness increases, especially in areas with high population densities, the creation of off-farm employment for the rural poor assumes additional urgency. Regrettably, simply creating jobs is not, in itself, a guarantee that the welfare of the rural poor will be significantly improved. The terms of employment must offer better conditions than those endured by most landless agricultural workers.

Modernization and strengthening of the agricultural sector carries potential for related industries and services that could help to absorb rural labor. Experience suggests the need for close integration of primary and secondary activities so that processing, service, and supply industries do not become primarily a conduit for siphoning rural savings into urban investment.

One expressed concern is that the divergence between developed and developing countries in population growth rates implies a corresponding dualism in achieving economic gains and limiting environmental losses. Robert Repetto argues that the richer countries, with high per capita incomes and relatively stable pressures on natural resources, will find it much easier to invoke protective policies for the envi-

ronment than developing countries where both rural and urban populations are still expanding, technical expertise is scarce, and limited public funds must cover such priority items as servicing external debt and providing urban services and employment for a growing labor force.[80]

A succinct summary of the critical nature of the responsibilities now facing governments in regard to population issues was made by Rafael Salas:

"The experience of developing countries shows that although many positive developments accompanied the march of the billions their fate would have been better if the march had been slower. With lower fertility and slower population growth, problems of the environment would certainly be easier to handle, people at large would have benefited more from new inventions, and governments would have been able to concentrate more on productive investment for development. Beyond 5 billion, the path is dictated neither by chance nor by rigid fate. One path leads toward a balance between nature and human beings which will build a future to safeguard succeeding generations. The other will lead to difficulties which might degenerate into disaster if fertility decline is too long postponed. Only a committed combination of deep personal motivation and strong political will can inform the choice."[81]

Back to Malthus

Much has been learned since Malthus' time. Agricultural production, even without the possibilities being opened up by biotechnology, can do more than increase arithmetically. The changes since his time include massive growth in both numbers of people and amount of food. Rapid population growth remains a major problem, as does hunger.

We have learned that the balance among population, food, and resources necessary for survival is a continual process, a juggling act rather than a stable equilibrium achieved once and for all. We are learning that it is not only a physical problem derived from the laws of nature, but that it is equally a social and political problem. Locusts attacking a swath of Africa can be stopped, as they were in 1986; desert areas can be made to bear fruit—the physical problems are solvable: we must learn to resolve the human problems. □

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Suggested Reading

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